

a contributing factor in the further development and maintenance of storm energy.

To take the very fact which Mr. Dines cites, namely, the exceptional storminess of the Atlantic to the north-west of Scotland. This region is, in a most conspicuous degree, stormier in the winter months than in the summer, and it is almost one of the canons of physical geography that the excessive development of storm-energy during the cold season is favoured by the great contrast in temperature between the frostbound continents and the warm Atlantic, the individual cyclonic systems breeding not so actively over the land areas, where the general pressure is high, as over the oceanic areas, where the general pressure is low. On the other hand, during the warm season—when the temperature gradient between the oceans and the continents is reversed, but is much less steep than the winter gradient—cyclonic energy in the North Atlantic is far less powerful, whilst over the sun-heated continents storm-energy takes the form, not of extensive wind-systems, but of localised convectional thunder-systems. Furthermore, in the southern ocean, between 40° and 60° S., where there are no disturbing land masses, there does not appear, judging from the reports of navigators, to be such conspicuous seasonal difference in storminess, and this is borne out by statistics available for the Falkland Islands (Meteor. Office Geophys. Mem., No. 15).

L. C. W. BONACINA.

November 19.

SIR OLIVER LODGE'S suggestion and mine in NATURE of November 25 are not contradictory, but rather complementary. Work done by the alternate evaporation and condensation of moisture implies a thermodynamic cycle. Both air and aqueous vapour must, I think, play the part of working substance.

J. R. COTTER.

Trinity College, Dublin, November 26.

Luminosity by Attrition.

ALLOW me to add to the list of minerals showing this phenomenon one which I have already given in my book "Diversions of a Naturalist." It is that of corundum. I found that water-worn pebbles of corundum (so identified in the department of minerals of the Natural History Museum) gave flashes of light when rubbed together, but required for this result a heavier pressure than do pebbles of silica. The same odour as that observed when silica is used was produced.

I may also repeat here what I have stated in my book, that a spectroscopic examination of the luminous flashes of quartz pebbles gave a continuous spectrum and no detached bright lines.

E. RAY LANKESTER.

November 28.

SOME ten years ago when grinding down a thin slice of limestone under water I was surprised to find that the operation was accompanied by faint flashes of light which seemed to issue from certain spots of superior hardness; on examining the slice under the microscope it was found that these spots consisted of quartz. This led me to devise an apparatus by which the luminescence could be continuously produced and so rendered a subject for precise observation. The substance to be examined was attached to the free end of a hinged bar and adjusted so that it rested against the edge of an emery, or, still better, a carborundum, wheel which was rotated by an electric motor. Of some forty minerals experimented upon no fewer than eighteen emitted light while

being ground. Those that did not included all the sulphides which were examined, viz. zinc blende, cinnabar, antimonite, galena, copper pyrites, and arsenical pyrites. Iron pyrites, of course, yielded sparks, but these were not accompanied by triboluminescence. Almost all the silicates emitted light, e.g. orthoclase, labradorite, idocrase, garnet, tourmaline (one variety, another did not), epidote, zircon, topaz, and glass; several oxides, e.g. corundum, magnetite, hæmatite, cassiterite, quartz, and flint; light was also obtained from wavellite, apatite, celestine, and barytes. But the most remarkable results were obtained from fluorspar; all the varieties of this mineral which were examined gave light, but one in particular, distinguished by its green colour, emitted blue light, not only in great quantity, but also of such persistency that the whole periphery of the wheel was alive with it.

Curiously enough, no electrical phenomena were observed in any case; an electroscope, possibly not a very sensitive one, gave no signs even when fully exposed to the current of dust driven off during grinding.

The light emitted was in most cases white, but often coloured reddish or yellowish, and in a few instances bluish. It would be quite possible to examine (as I did) the light with a spectroscope, and after some preliminary trials I planned apparatus for photographing the spectrum. The outbreak of the war, however, put a stop to my experiments, and I have not yet had time to resume them.

November 25.

W. J. SOLLAS.

Stellar "Magnitudes."

MAY I ask whether it is not time to overhaul and improve the conventional specification of stellar magnitudes?

When first introduced, on the basis of ordinal numbers, the plan was natural enough; a third magnitude was naturally inferior to a first, and a group of some twenty stars could be considered as of the first magnitude.

But when it was found possible to measure and specify magnitudes with numerical accuracy—by instrumental means not, I confess, fully known to me—so that a Variable could be said to decrease from 2.14 to 2.56, the cardinal number specification looked inverted. Moreover, magnitudes less than unity became necessary for the brighter stars, and a sufficiently bright star would presumably have the magnitude 0; a nova, for instance, might blaze up from magnitude 12 to magnitude zero, or even become of negative brightness at the height of its career. Indeed, I gather that a more recent system, of what are called "absolute magnitudes," really does involve negative numbers.

Would it not be well to reconsider the convention and devise something more convenient?

OLIVER LODGE.

Higher Forestry Education for the Empire.

THE question has been recently raised by the Government of India as to the advisability of either training the probationers for the Indian Forest Service entirely in India or confining the training to one centre in this country. The question has come to the front owing to the changes to be introduced in the administration of India, under which a larger proportion of Indians will enter the Indian Forest Service in the future, it being therefore considered desirable to train the European and Indian probationers all together. The professional forestry opinion of Indian

officials, with which Prof. Troup and I agree, would appear to be unanimous in condemning the possibility of training the forest probationers in India owing to the fact that the Indian forests are, as yet, very far from having reached the standard necessary to provide students with the full practical object-lessons which are to be seen only in forest areas which have been under scientific management through one or two rotations of the crops.

The alternative suggestion is to revert to the one centre at home, which was given up when the forestry branch at Coopers Hill was closed down in 1905. This question of one centre was considered at the Empire Forestry Conference held in July last in London. The Forestry Commissioners suggested that a new centre should be created apart from the universities, and that both Indian forest probationers and the Colonial and Dominion probationers required for the Empire should be trained at the centre. It was suggested that the probationers should be selected from graduates in natural or pure science at the universities, and that these probationers should then be sent to the centre to undertake a two years' course in forestry and the applied science subjects. The conference voted in favour of this proposal. The situation of the centre, whether at one university or apart from the universities, was left in abeyance. The Indian Government representatives wished the centre to be at one university at which a forestry college should be erected for the probationers, the latter otherwise taking advantage of the university courses, laboratories, and so forth.

At the present moment the three Universities of Oxford, Cambridge, and Edinburgh are recognised by the India and Colonial Offices as qualified to train their forest probationers. The suggestion to confine the training in the future to one university would be, therefore, subsidising one university as against the other two, thus involving the waste of the capital sunk by these universities in placing their forestry schools in an efficient position. To carry out the one university centre idea it would be necessary to obtain considerable grants of money from the Indian and Colonial Governments, and it is doubtful whether one university could be thus subsidised by the Government at the expense of the others. The suggested alternative is the one centre apart from the universities.

At the end of September last the Forestry Commissioners called a meeting of the heads of the schools giving forestry training in this country.

In the discussion on the one centre proposal the heads of the forestry schools of Oxford, Cambridge, and Edinburgh were unanimous in condemning the one centre away from the university, considering that it would introduce a rigid type of teaching which would give rise to a forest officer with a narrow outlook. It would also be difficult to get first-class teachers to take up appointments in an isolated centre. The cost of the new buildings and their equipment and the outlay on salaries would also be a very heavy charge. The period of three years for the science degree and two years for the later training in forestry was also deemed too long, involving the probationers joining the Services at an unnecessarily advanced age. They were also of opinion that the complaints of the Indian Government as to the inadequacy of the training of some of their forest officers were due to the present method of selection, many probationers being selected before they had any training in forestry or knew anything of the life of a forester. It is common knowledge at the university centres training for forestry that men, finding they have no taste for the forestry subjects, change over to

another side of the university at the end of their first year and while there is still time to do so. The selected forest probationer with a Government training grant is not often in a financial position to enable him to throw up his grant. Yet the proposal for the single centre away from the university is based on the continuance of this selection system. The heads of the university departments were also strongly in favour of the higher forestry education being given at the university, as the men, European and Indian alike, profited greatly by mixing with others training in other branches.

It became apparent at the Empire Forestry Conference that many of the delegates had only a superficial acquaintance with the latter-day developments in forestry education at the three Universities, which, to a great extent, have been the result of the work of the last decade.

With the view of providing for the India Office requirements that *esprit de corps* should be engendered amongst its probationers by living together, and also the practical needs of the future forest officer, which are now greater than they were, I made the following suggestion:—That the forestry probationers for India and the Home and Colonial Services should be selected from the men who had obtained a degree or diploma in forestry at the universities, and that these selected probationers should then be sent for a period of six months or a year to the new Empire Research Institute, which the Empire Forestry Conference delegates suggested should be inaugurated in this country. The probationers could be given such specialised courses as were required at this centre with a very small extra expense. The Indian probationers would thus live together during part of their training, and that *esprit de corps* required by the Indian Government would be engendered.

In the Memorandum of the Education Committee of the Conference (White Paper, Cmd. 865, p. 15) it was stated that my proposal *in re* extra specialised courses was "a tacit admission that existing courses were capable of extension with advantage." I have shown that time will not permit of an extension of the curriculum during the three years required for the forestry degree. The question of extending the degree course to four years has been under consideration at Edinburgh. The Indian Government delegates have stated that the forest officers of the future would be the *corps d'élite* of the Indian Forest Service. I fully agree with this view. To train the men to this standard will require extra specialised or advanced courses, and these can be given either at the universities or, as in my suggestion to meet the views of the Indian Government, at the Empire Research Institute.

Apart from India, the suggestion of the one centre is made on the ground that it will prove cheaper owing to the large demand for grants in aid of forestry education which have been made to the Forestry Commissioners; but in this matter of the higher training for the forest officer only three universities in this country are at present in question.

It should be possible to find out what additional funds the three universities require to maintain their schools in the highest possible efficiency, and this amount, combined with the additional sum required for the extra training of the probationers at the Empire Research Institute, would be likely to be far below the amount, to which India and the Colonial Office would have largely to contribute, which would be required to create a new isolated centre apart from the universities.

The decision on this point of the future of the higher forestry training is a momentous one, since it involves no less than the future correct management of the majority of the forests of the Empire.

E. P. STEBBING.

University of Edinburgh, October 29.

British Laboratory and Scientific Glassware.

I HAVE read with much interest the letters in NATURE of November 4 from Prof. Bayliss and Mr. Frank Wood on the subject of British glassware, and I think the whole truth lies, perhaps, between the two opinions put forward. As a manufacturer of scientific apparatus, and primarily of X-ray tubes, I have had probably as trying an experience of glass as any manufacturer since 1914.

It is well known, I presume, that prior to the war the whole of the glass bulbs and tubing used in the manufacture of X-ray tubes came from Germany, and the quality was undoubtedly very fine indeed. Since 1914 we have been obliged to depend upon glass of French, American, and English manufacture. Although by no means without merit, the products of the two first-named countries were discarded directly the English makers were in a position to give us anything at all adequate to work with, and since 1916 I think we have not used any glass whatever other than that made in this country.

At the present time the position is that a glass reasonably good for our purpose is made by at least two British firms. It works well in the flame and preserves a good appearance, but it is impossible to say that it has reached the high standard set by the German product. So far as the purchasers of the finished instrument are concerned they are not affected, because the imperfections of the British glass, where they exist, manifest themselves during the manufacture of the complete X-ray tube, and the difficulties, therefore, are entirely connected with manufacture, and not with the efficiency of the working of the apparatus which is being constructed.

It has seemed to me for a long time past to be a matter for regret that the British manufacturers could not make those small final improvements which would give us exactly the material we require instead of, as at present, stopping a little short of the ideal.

I believe there is no particular difficulty at the moment in obtaining supplies of glass from Germany, but up to now I have resisted every temptation to do this, partly on general sentimental grounds, but largely because of the enormous amount of trouble which has been taken by the two firms of which I spoke in order to produce a glass suitable for X-ray purposes. I am sure that from start to finish the profit on this undertaking must have been negligible, and there have been endless experiments and a very large amount of waste, the cost of which has fallen chiefly on the glass manufacturers themselves.

For this reason I feel that every endeavour should be made to place the British glassmakers in a position whereby they could continue to produce these special glasses, the demand for which is comparatively small, but which are, nevertheless, of the very greatest importance to scientific workers in this country. Those firms engaged in my particular branch of the electro-medical industry are always only too ready to co-operate in every possible way with the glass houses in order to secure in this country absolute independence in the matter of the supply of material.

CUTHBERT ANDREWS.

47 Red Lion Street, High Holborn,
London, W.C.1, November 25.

NO. 2666, VOL. 106]

Heredity.

IN his letter to NATURE of November 25 Sir Archdall Reid has ably stated some fundamental biological truths concerning heredity, and with many of his statements I believe all biologists would agree. From the developmental point of view there is certainly a sense in which all characters are alike, arising as the result of the interplay of the germ and its environment, nature and nurture. In this limited sense it is doubtless beside the mark to inquire whether nature or nurture is more important, seeing that both are essential elements in any development at all. From this point of view it may be true, to cite Sir Archdall Reid's example, that there is no fundamental difference between the head and the scar; both may be in one sense germinal, and in another acquired.

But this does not go to the root of the matter, as may be most readily pointed out by referring to the latter part of the letter in NATURE. Sir Archdall Reid says: "The sole antecedent of non-inheritance is variation." The statement is true, of course, but he goes on to assume tacitly that all variations are in one category. Sir Archdall Reid recognises the fact, which Weismann emphasised, that "heritage travels down the germ-tract," and draws the "*necessary* [his italics] inference from this" that all characters of the individual are "innate, acquired, and inheritable in exactly the same sense and degree." But this is surely a *petitio principii*, for while all inherited characters may come to travel down the germ-tract, it does not follow that they all originated as variations in the germ-tract. It is surely legitimate to assume, until the contrary is proved, that new characters may arise (to use ordinary biological terms) as germinal variations or as impressed modifications of the soma which are not represented in the germ-tract. Indeed, this is the current distinction drawn between mutations and fluctuations. In the latter case the question will arise whether the modified soma may ultimately affect the germ-plasm; in other words, whether a modification or an acquired character may come to be inherited by bringing about an alteration in the germ-plasm. This is surely a legitimate inquiry. If so, it implies the possibility that the "scar" might ultimately, having become germinal, appear without the specific stimulus that is now necessary to call it forth.

R. RUGGLES GATES.

King's College, Strand, W.C.2.

The Mechanics of Solidity.

UNDER this title Mr. J. Innes (NATURE, November 18) suggests, for the benefit of engineers, that coefficients of thermal expansion are fairly closely related to hardness. His list of thirty-eight materials ranging from diamond to indiarubber is given in order of thermal expansion. No definition of hardness is suggested, and the figures, taken from three tables of "hardness," are admittedly somewhat conflicting.

Hardness, I take it, is due in part to closeness of atomic packing. Diamond, the hardest substance known, possesses also the lowest known atomic volume, while potassium, the softest element on Mr. Innes's list, has by far the highest atomic volume, i.e. has the loosest atomic packing.

Diversities in hardness depend also on how far each substance tested is removed from its melting point. Taking fourteen elements from the list, and assuming tests for hardness were made at uniform temperature, the order of degree-distance below melting point comes out:—Diamond, iridium, platinum, iron, gold, copper, silver, aluminium, arsenic, antimony, lead, tin, bismuth, and sulphur.